

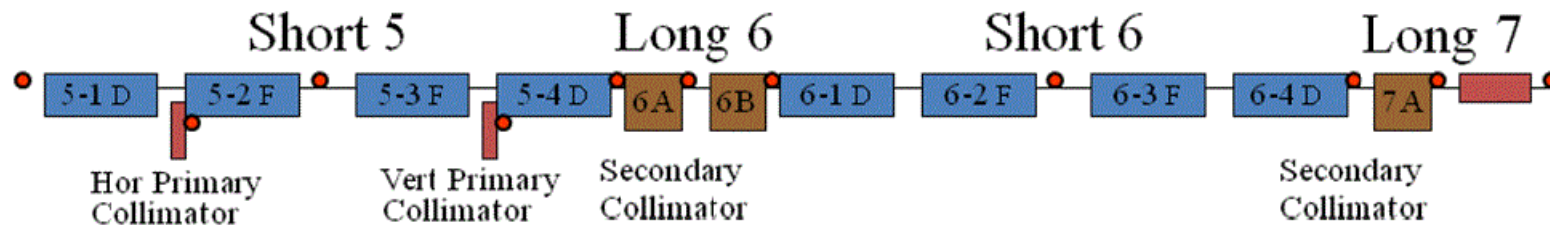
“Preliminary Analysis from Booster Collimator Studies”

Valery Kapin & Rick Tesarek

PIP General Meeting, Wed, 6 Apr, 2016

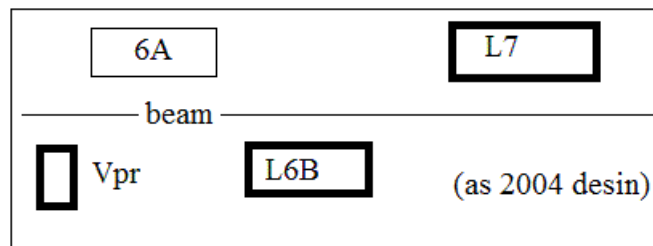
Acknowledgements & Intro

- Data acquisition & collimator motion control for vert. collimation study (17-Feb-2016) done by T.Sullivan, K.Triplett and S.Chaurize.
- Post-processing for BPMs & BLM by V.Kapin & R.Tesarek, resp.

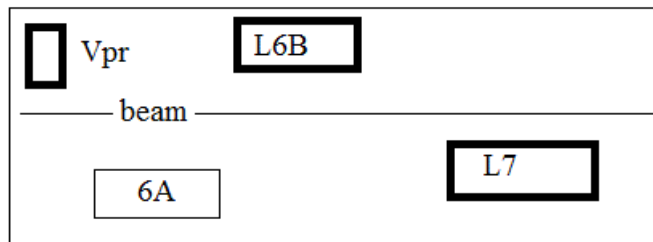


Two possible configurations:

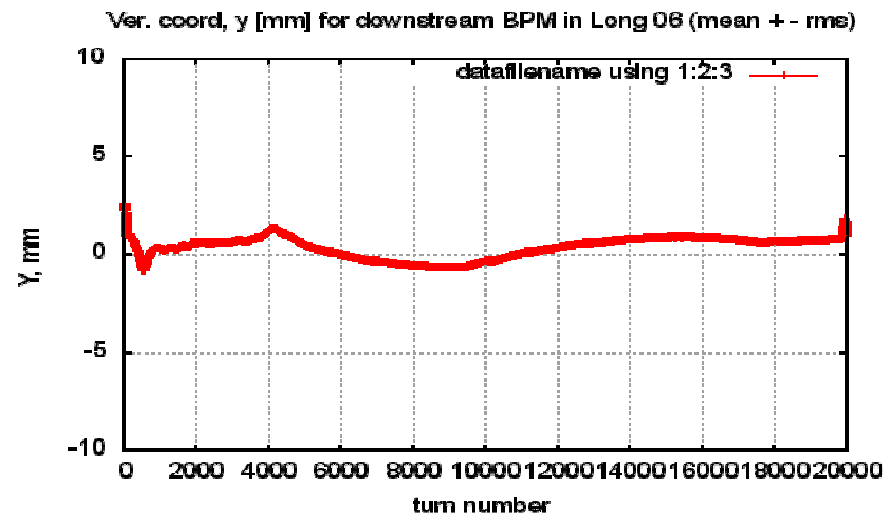
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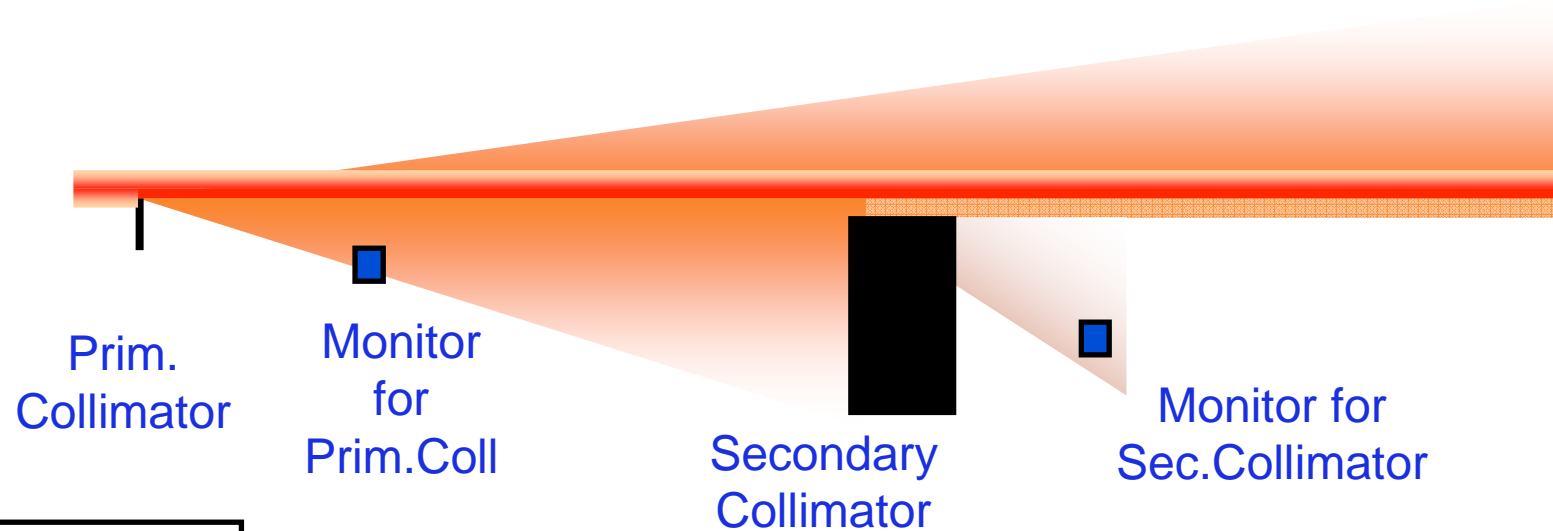
2



*L06 vert. orbit: beam up at extraction =>
Up scheme (1) as 2004 design by Drozhdin*



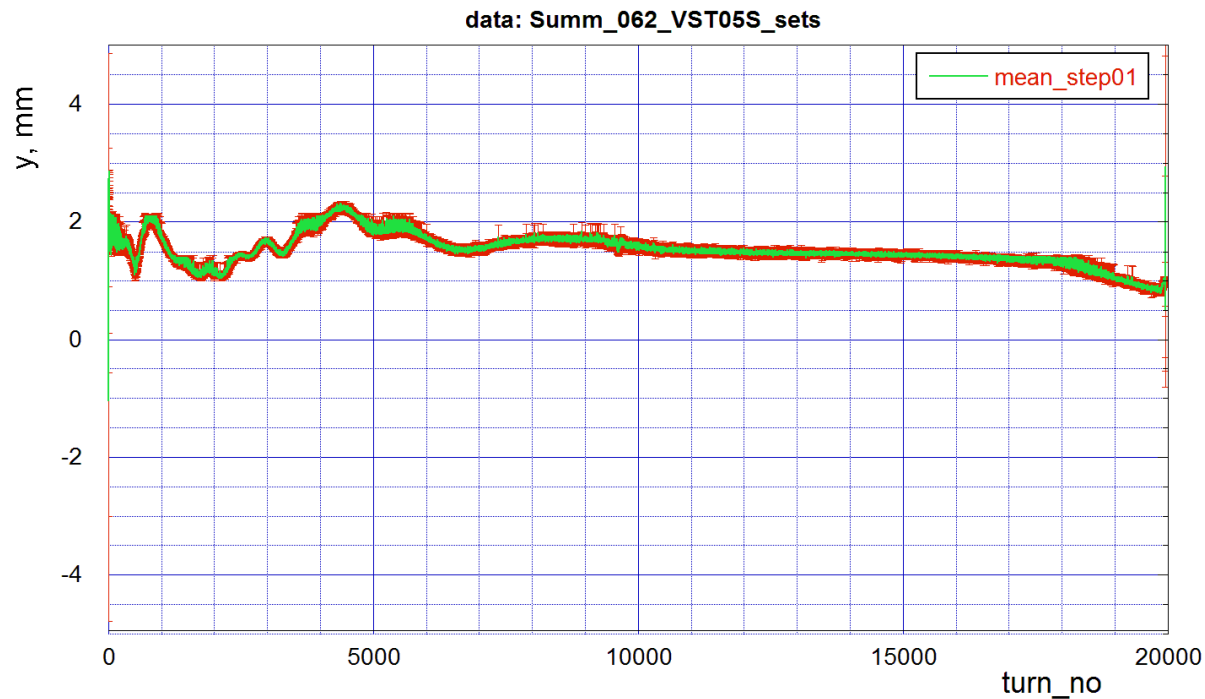
2-stage collimation (scheme & study steps)



Study Steps			
1	<i>Record BLMs & BPMs</i>	9	Vprim up-down (2-3 times)
2-4	all SecColls out (L6B-Vert in)	10	Col2(L6B): move up to beam
5	<i>Record BLMs & BPMs</i>	11-14	Col2 move up-down (optimize)
6	L6B-Vert out	15	<i>Record BLMs & BPMs</i>
7	<i>Record BLMs & BPMs</i>	16	Return all colls to ini conditions
8	Move Vprim to low "garage"	17	<i>Record BLMs & BPMs</i>

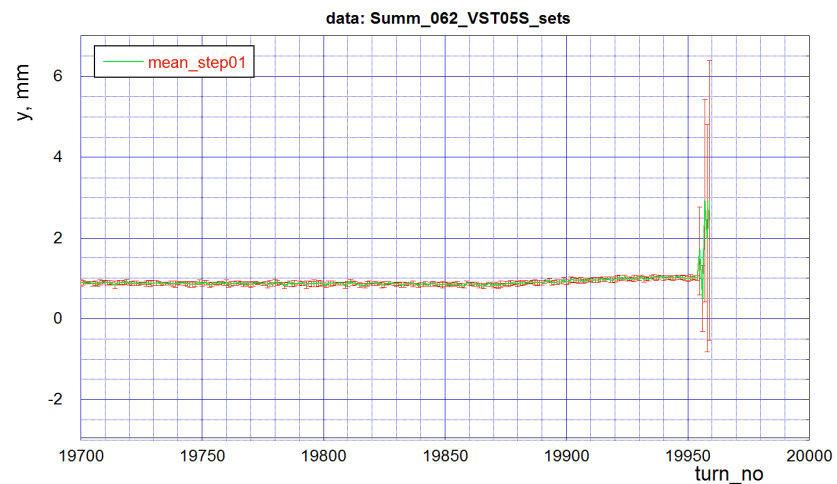
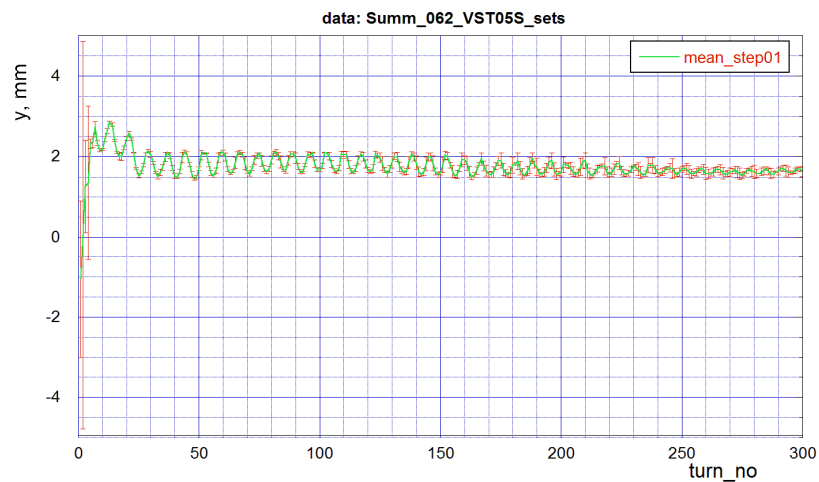
Off-line post-processing: data for BPM in S05

Measurements!



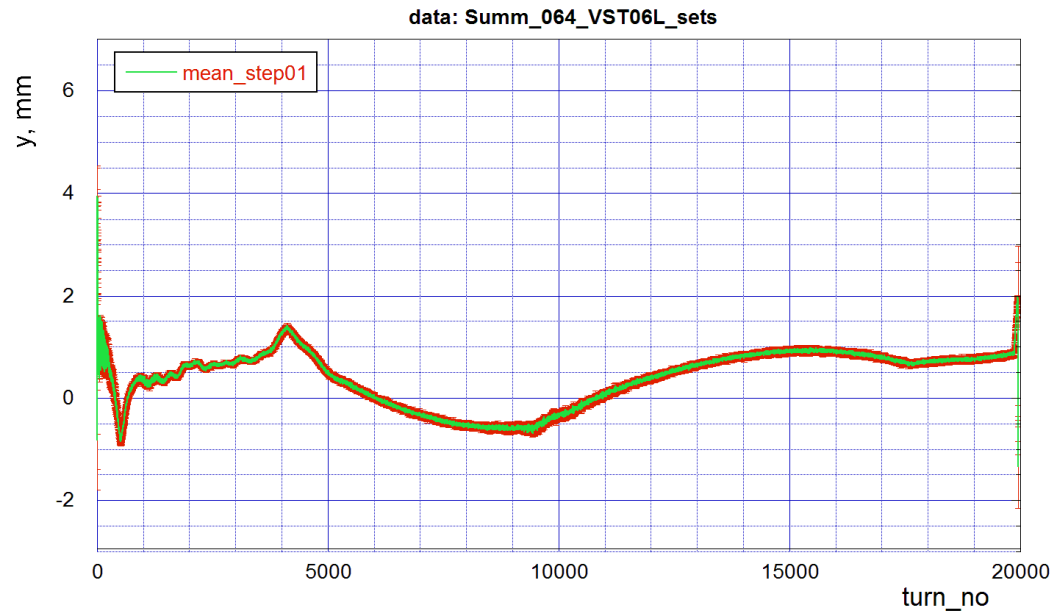
“Initial conditions” (step01):
Top (full booster circle);
Bottom (first & last 300 turns)

Mean (green) & rms (red) of
up to 5 measurements
at every step



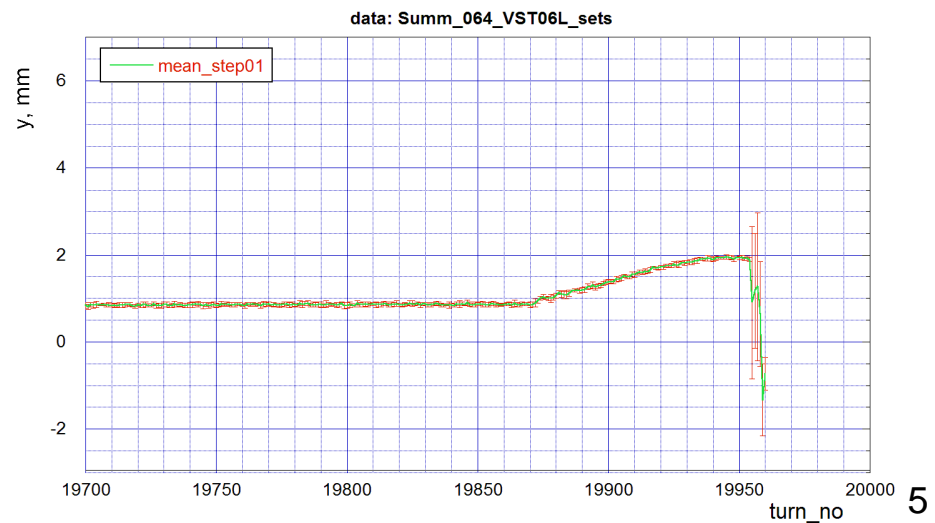
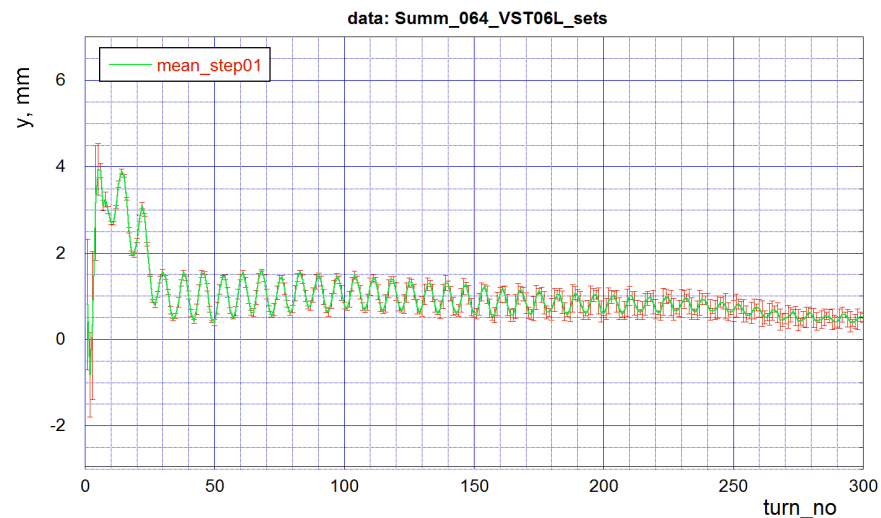
Off-line post-processing: data for BPM in L06

Measurements!



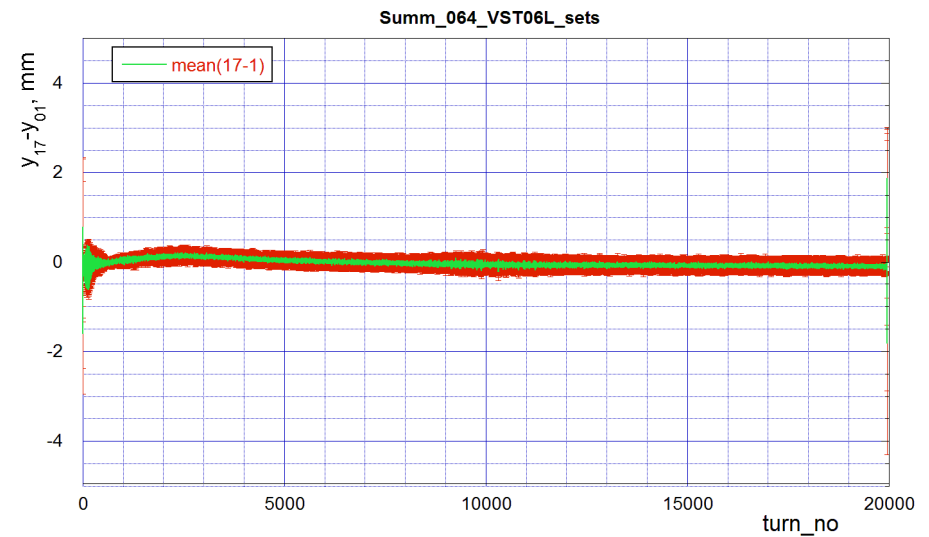
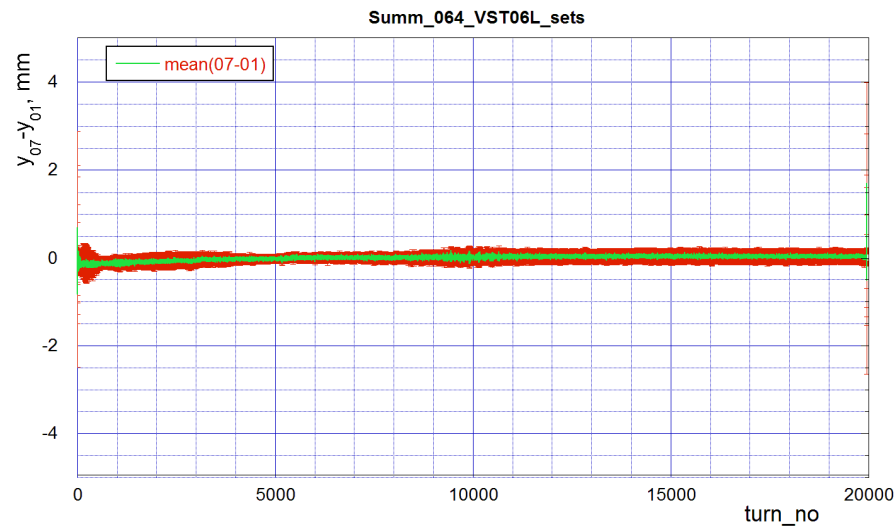
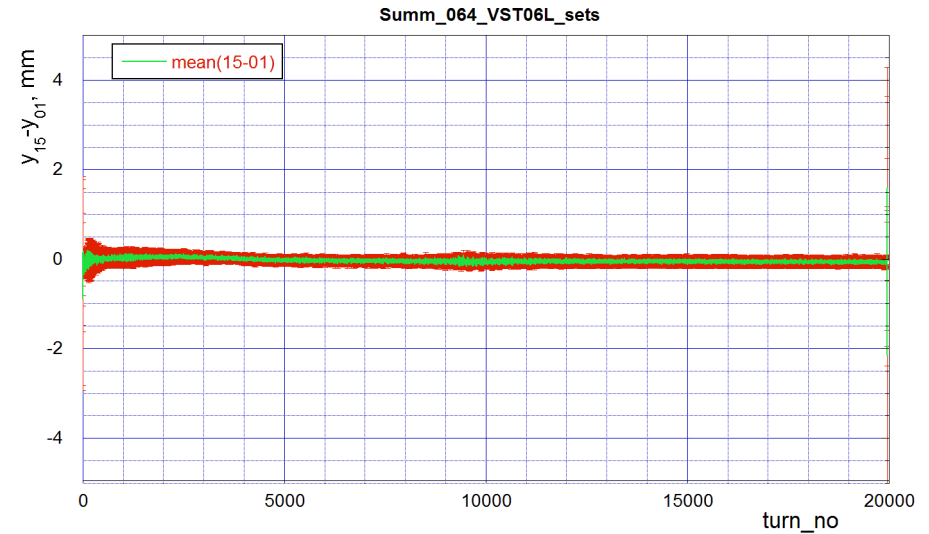
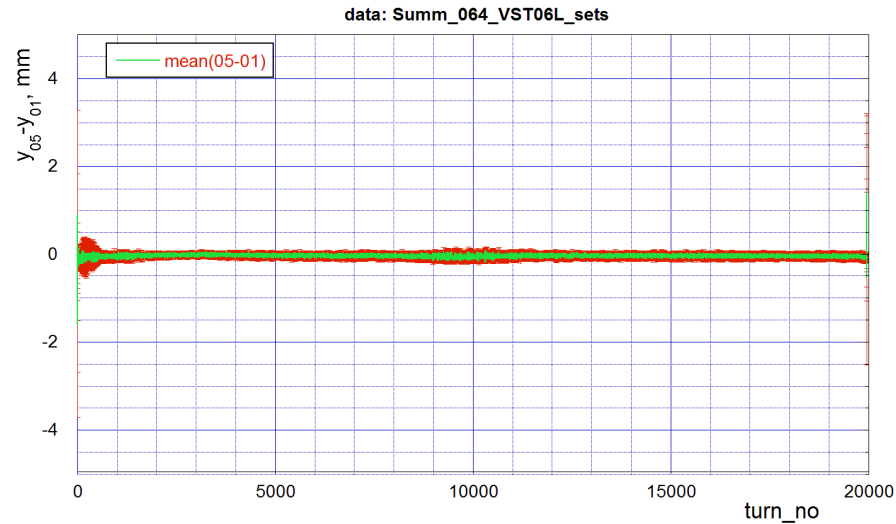
“Ini conds” (step01):
Top (full booster circle);
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On Stability of BPM data during study: L06

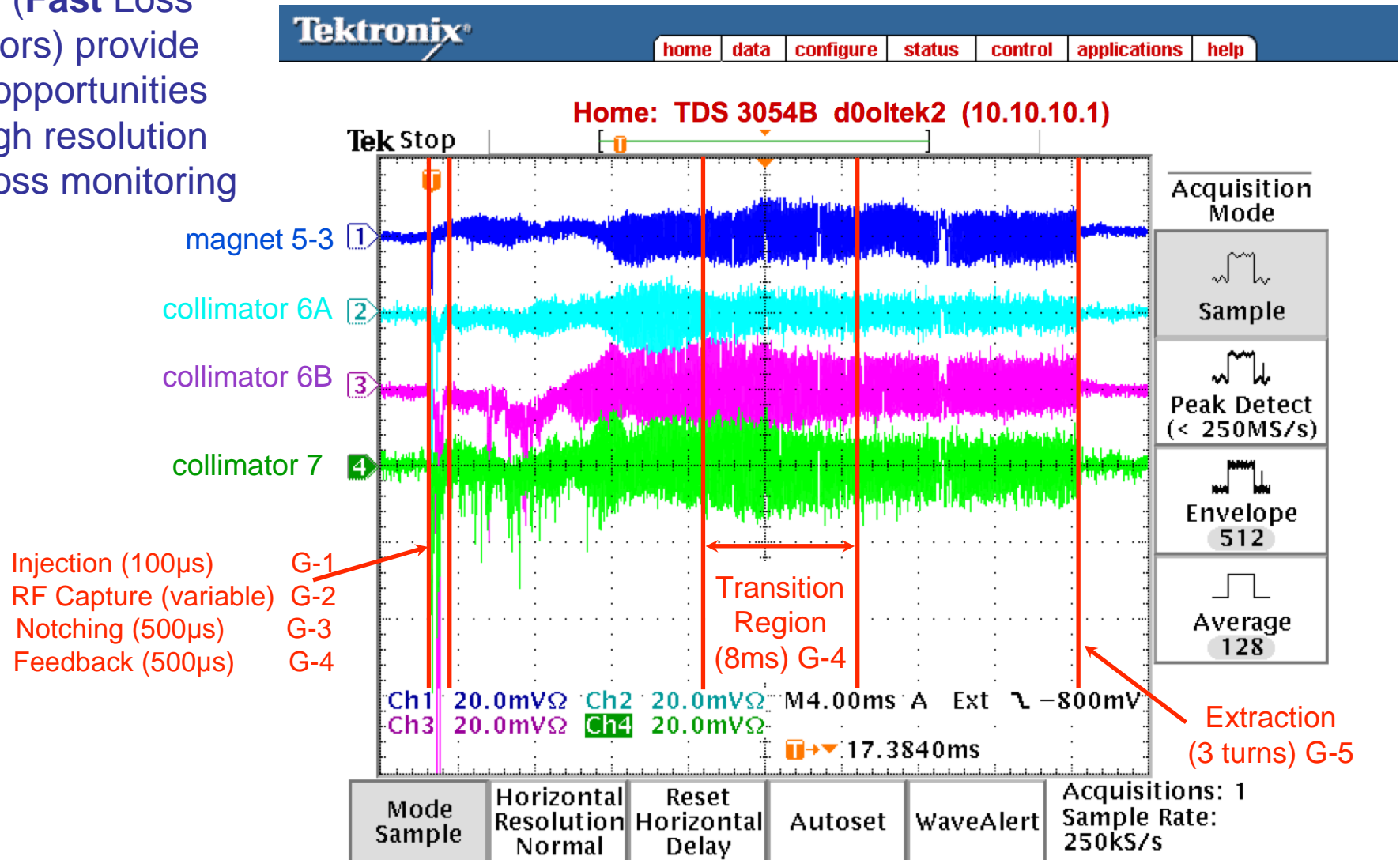
Difference from “Initial conditions” (step01) for other steps (5,7,15,17)



Beam orbit does not change for all steps

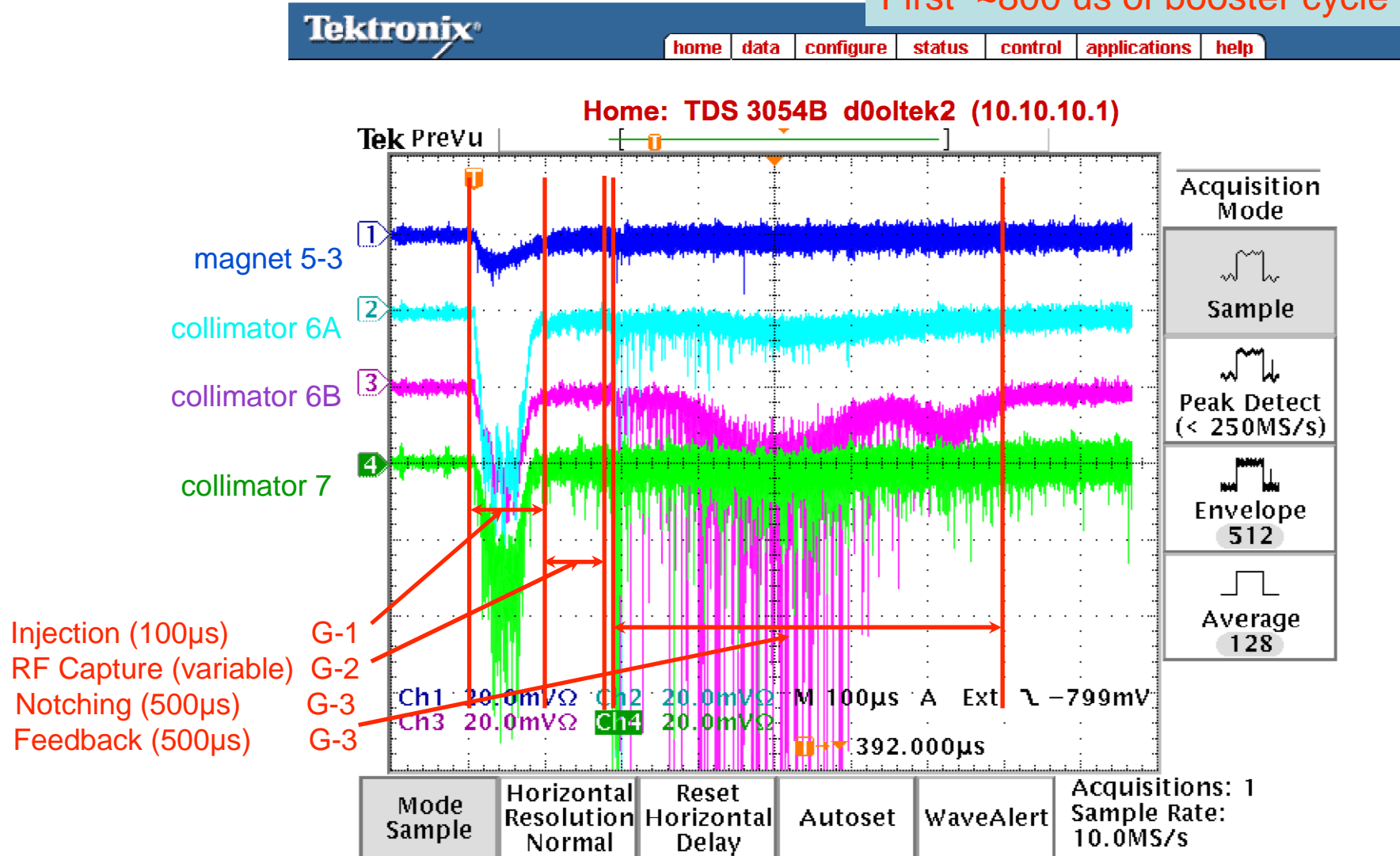
Booster losses: FLM for full booster cycle

FLMs (Fast Loss Monitors) provide *new* opportunities for high resolution (ns) loss monitoring

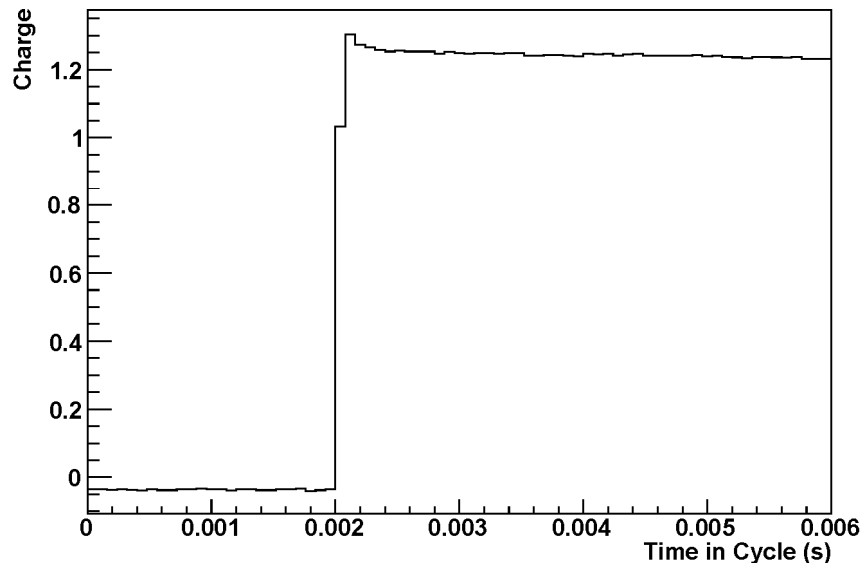
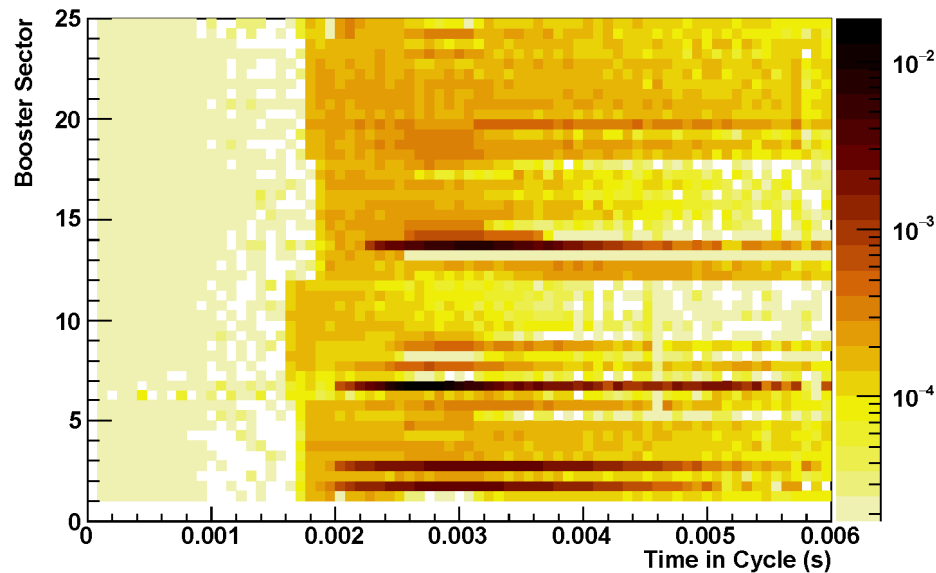


Booster Losses: details at <Injection – Feedback>

First ~800 us of booster cycle



BLM data: “initial conditions” zoomed at injection



“initial conditions” = a standard collimator settings for 1-stage.

The top plot are the instantaneous losses (diff. between consecutive readings: $R(i) - R(i-1)$).

The bottom plot shows the beam current.

Some Issues:

1. The BLMs data are not timed relative to one another at about the 300us level (see backup slide).

It appears that there are two groups (sectors 1-12 and 13-24)

2. Loss information from specific BLMs looks strange (see top plot).

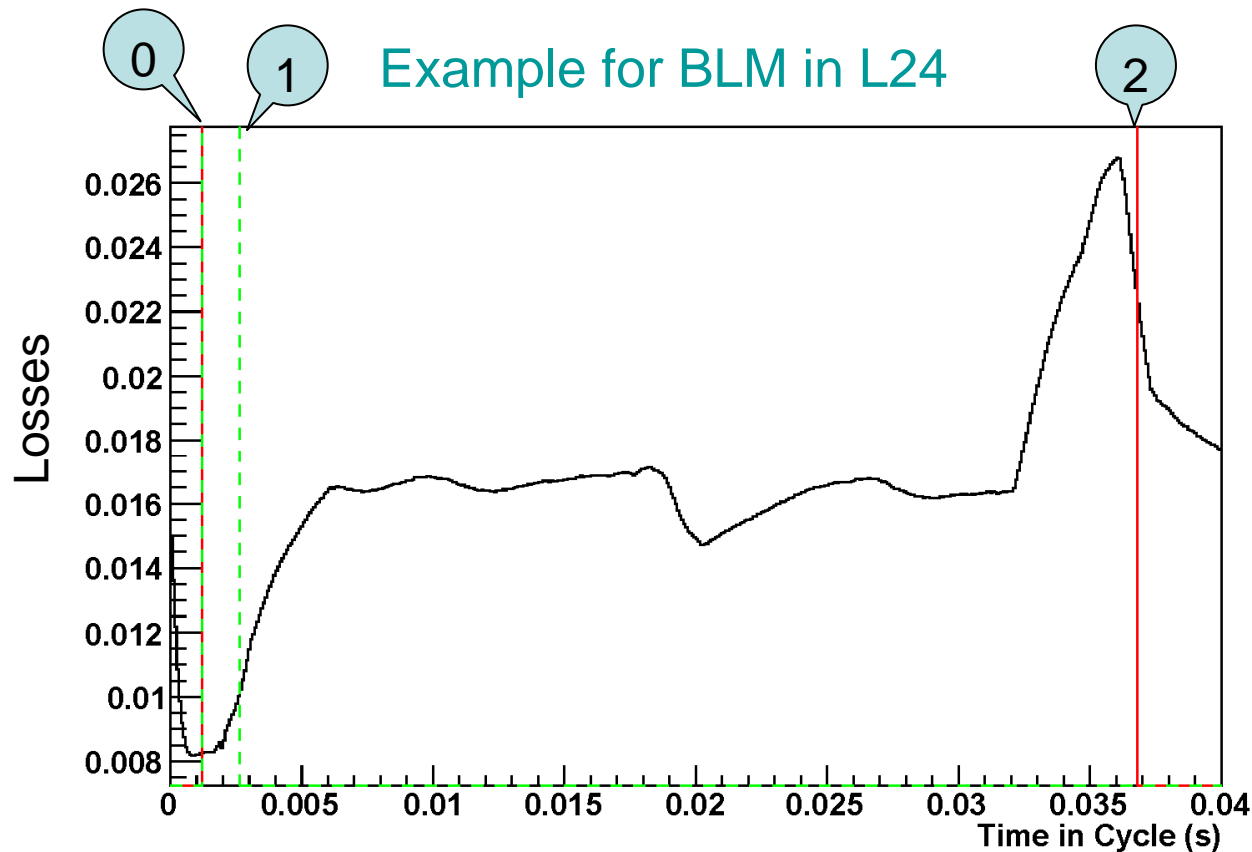
3. The beam current has a “negative pedestal” (see bottom plot).

BLM post-processing: definitions

Booster Loss profiles (losses vs BLM number)

Inj. Losses = $\text{Loss}(1) - \text{Loss}(0)$

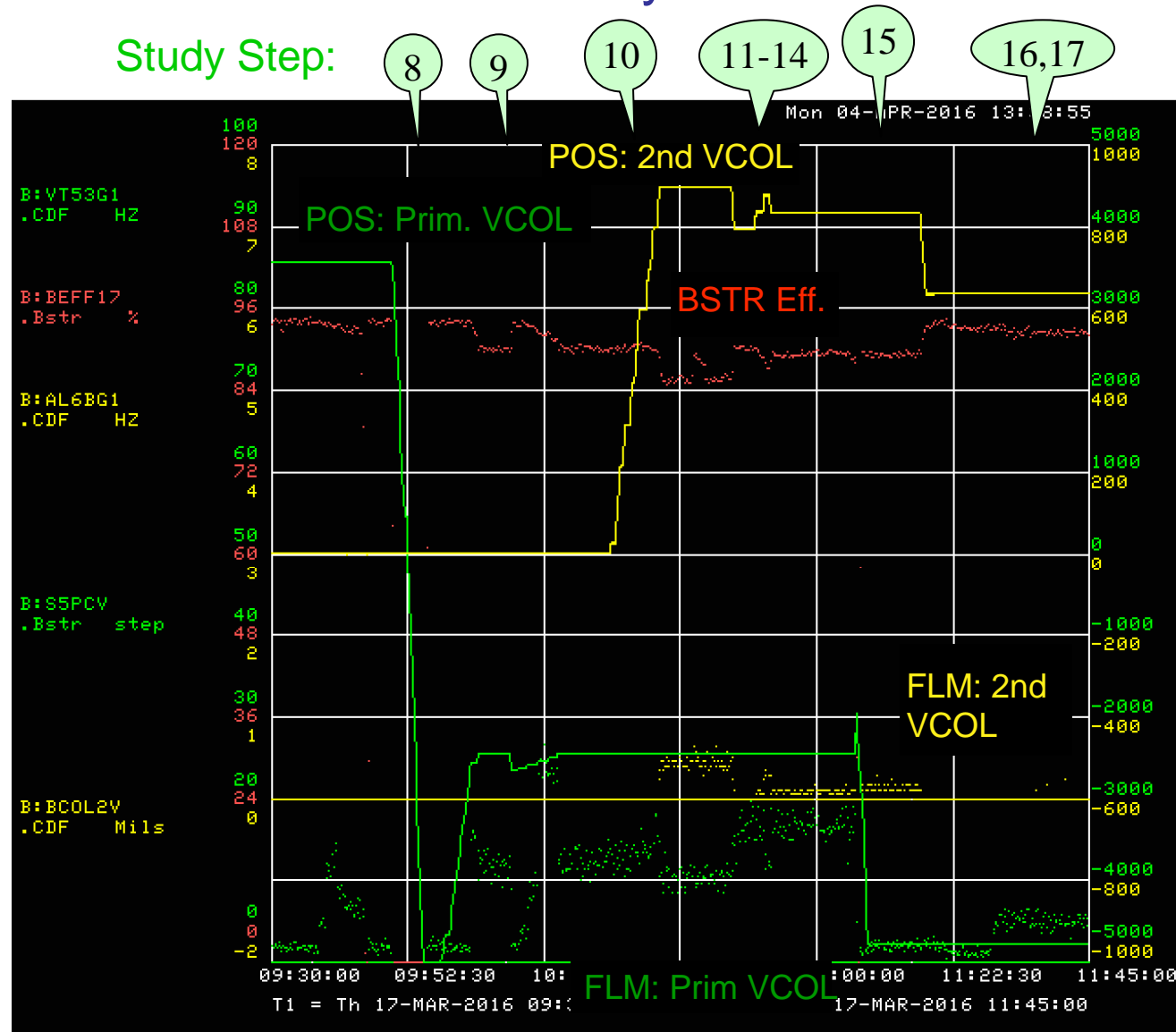
Tot. Losses = $\text{Loss}(2) - \text{Loss}(0)$



Two Stage Vertical Collimation Study

NOTES:

- Lines are collimator positions.
- Dots are feedback devices (loss rates, booster beam efficiency)
- Just to check that 2 stage system works, NOT OPTIMIZED



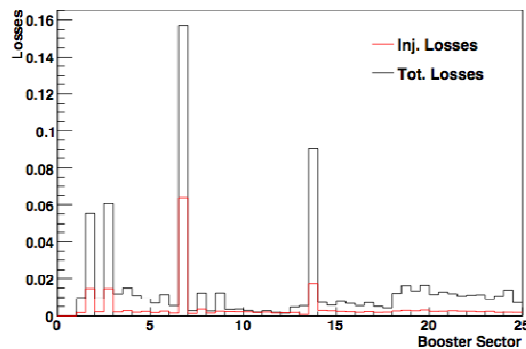
Parameters on the above plot can be monitored online during beam studies

Two Stage Vertical Collimation

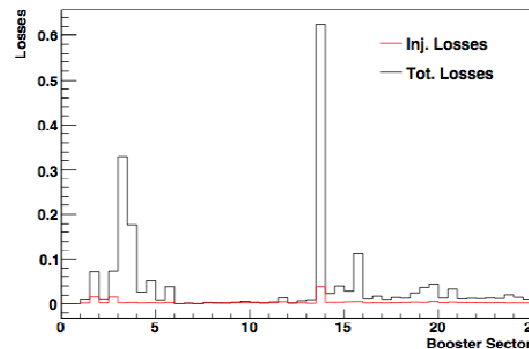
Notes:

- Vertical scale on linear plots different
- No collimation means notcher-absorber is aperture restriction (collimator)
- ➔ Two stage system works! (but not optimized).
 - Beam eff. lower than standard config during studies of 2 stage system
 - Beam during studies near detection thresholds for FLM

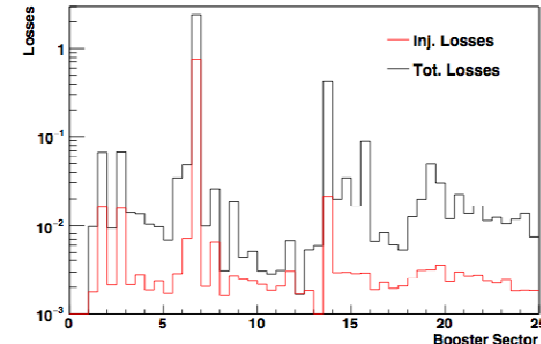
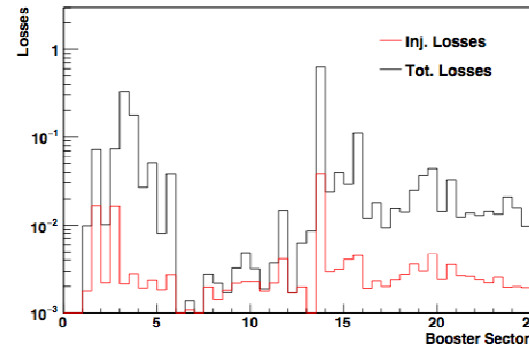
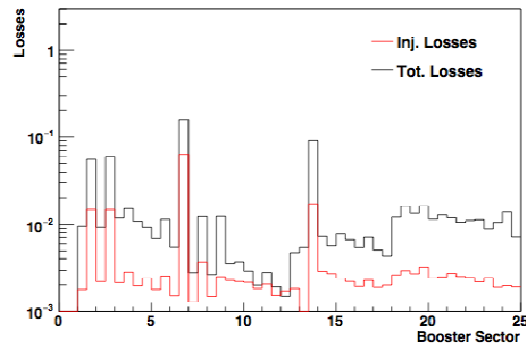
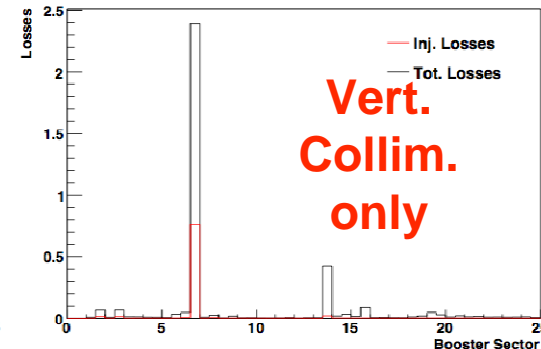
Standard Conditions



No collimation



2 Stage Collimation



Conclusion & Outlook

Conclusions

- Tools for post-processing of beam orbits (B38) and BLMs (B136) have been created
- Preliminary analysis has demonstrated a good stability of orbits during all session (event 17).
- Analysis of BLM data: 2-stage vert. collimation works (fraction of p scattered by PrColl then lost on SecColl6A)
- Some issues for BLMs data (B136) should be resolved
- Broken upstream vert. BPM in L06 needed to be repaired

Next

- Next question: to understand if 2-stage collimation is better than existing 1-stage collimation
- Next steps: to finish BLM analysis and work out plans for next beam studies

Backup slides

Example: BLM in L24

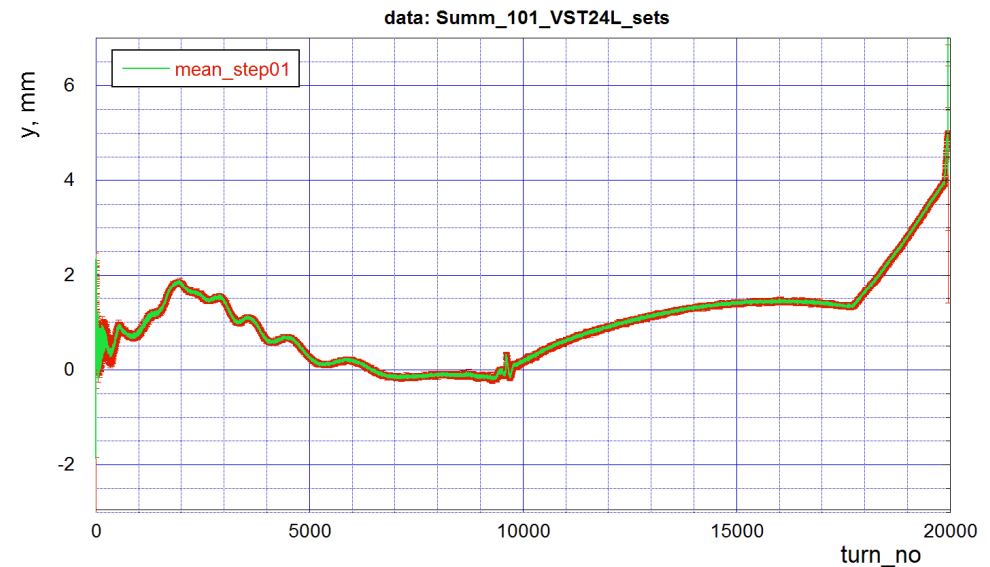
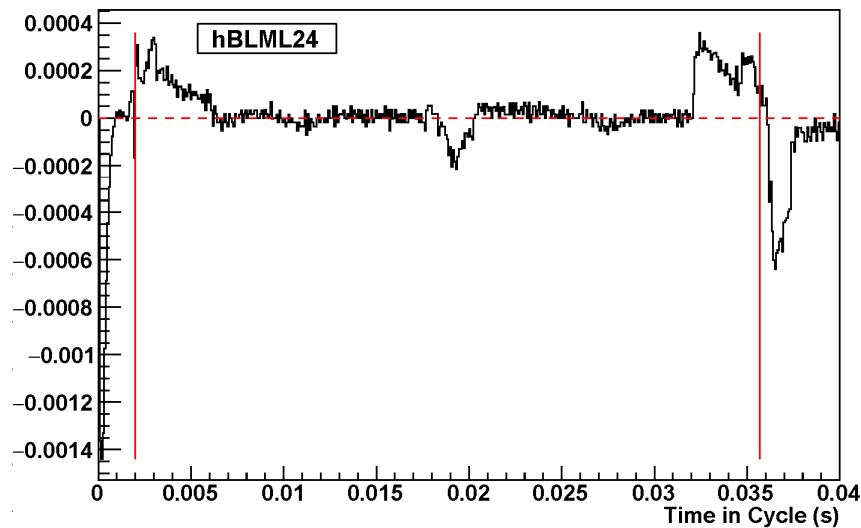
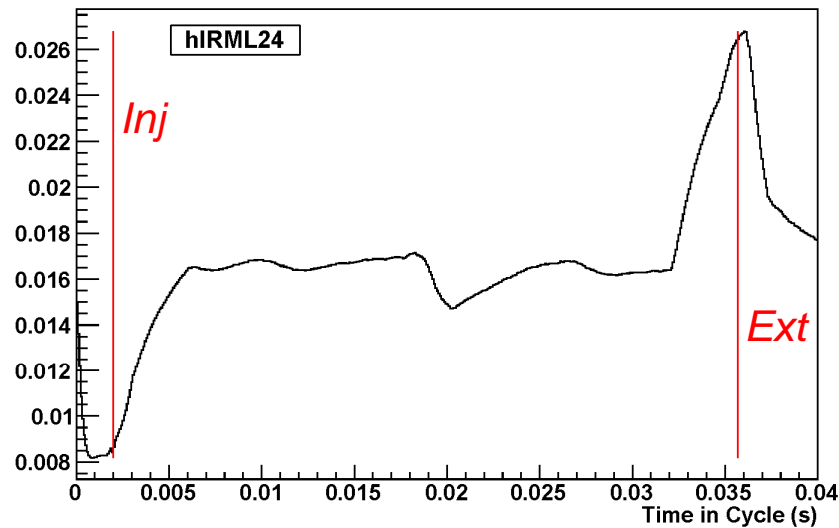
Integrated losses (top) and instantaneous losses (bottom).

Red lines: injection & extraction

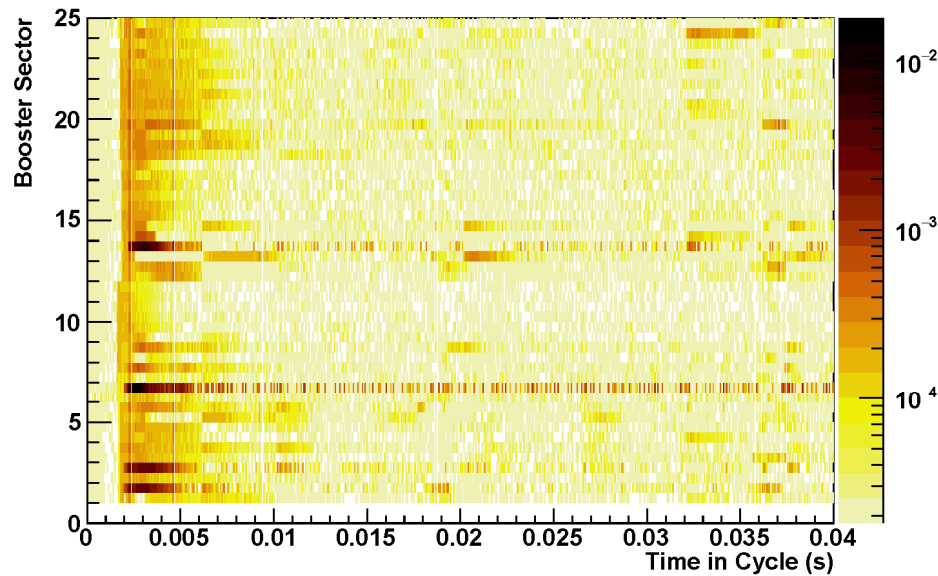
Issues:

fast drops of integrated losses
Negative values of differential (instantaneous) losses

Vert. orbit in L24



BLM data: losses for “initial conditions”



“initial conditions” = a standard collimator settings for 1-stage.

The top plot are the instantaneous losses (diff. between consecutive readings: $R(i) - R(i-1)$).

The bottom plot shows the beam current.

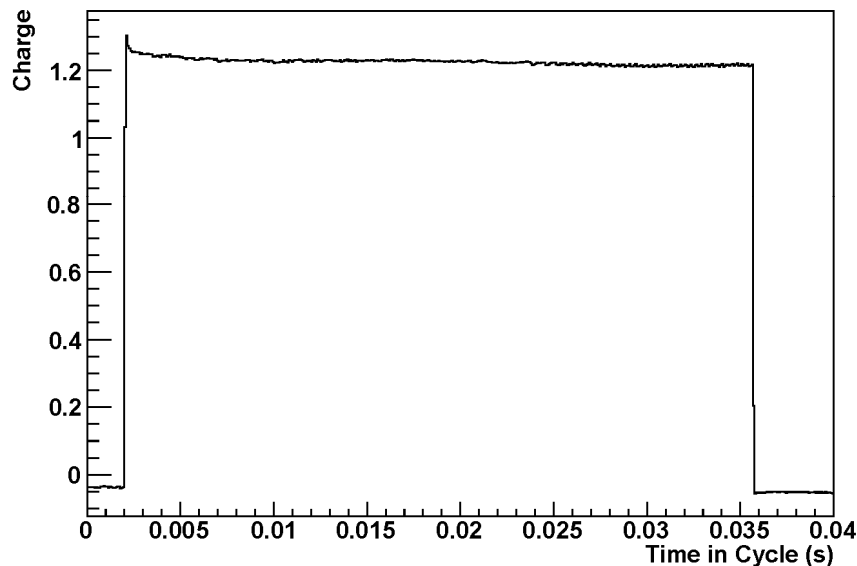
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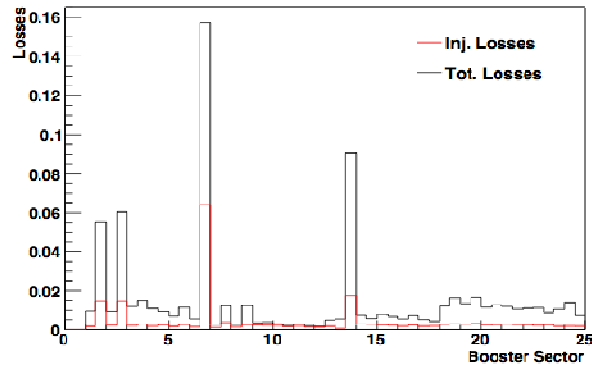
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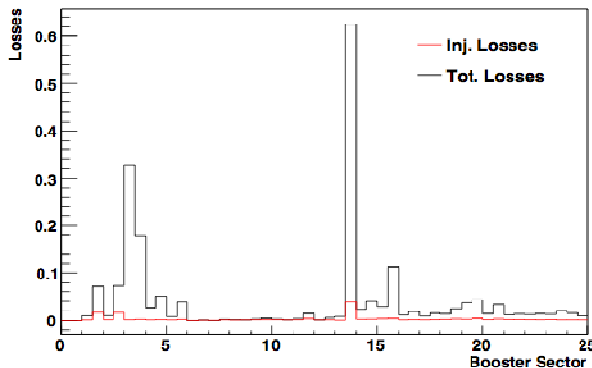


Two Stage Vertical Collimation

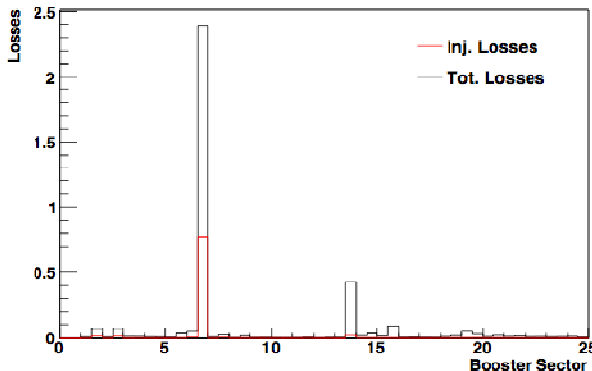


Integral Beam loss distribution around the booster at injection (red) & extraction (black).

Top: Ini. condition (1-st.coll. – with **all** colls)
large losses at L3, L6, L13(Notch-absrb)



Middle: all collimators out
large losses at L3 & L13



Bottom: 2-stage vert. collimations using only VPrim and SecColl (L6A), while L7 is out
*large losses at L6,
relatively smaller at L13
neglegible(?) at S05 (VPrim)*

Notes:

different vertical scale for plots;

studies done at small beam current

Could not compare 1 & 2 stage collimation yet